



REVIEW ARTICLE

Association between gestational age and birth weight on the language development of Brazilian children: a systematic review[☆]



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KEYWORDS

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Abstract

Objective: To review the literature that addresses the relationship between prematurity, birth weight, and development of language in Brazilian children.

Sources: A systematic review of studies published between 2003 and 2012 in English and Portuguese and indexed in PubMed, LILACS, and SciELO. The following key words were used in the searches: Prematuro, Prematuridade, Linguagem, Prematurity, Language, Speech-Language Pathology. Fifty-seven articles were retrieved, 13 of which were included in the systematic review.

Summary of the findings: The results showed an association between prematurity, low birth weight, and language development. In studies that made comparisons between preterm and term infants, there was evidence that preterm infants had poorer performance on indicators of language. It was also observed that children born with lower birth weight had a poorer performance on measures of language when compared to children with higher weight and closer to 37 weeks of gestational age. Regarding the type of language assessed, expression proved to be more impaired than reception. Higher parental education and family income were indicated as protective factors for the development of language. Conversely, lower birth weight and higher degree of prematurity emerged as risk factors.

Conclusions: Preterm birth and low birth weight poses risks for the language development of children, especially in the first years of life. Therefore, it is essential that pediatricians are aware of the language development of these children to ensure proper treatment.

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PALAVRAS-CHAVE

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linguagem

Associação entre idade gestacional e peso ao nascimento no desenvolvimento linguístico de crianças brasileiras: revisão sistemática**Resumo**

Objetivo: Revisar a literatura que aborda a relação entre prematuridade, peso ao nascimento e desenvolvimento de linguagem de crianças brasileiras.

Fontes dos dados: Revisão sistemática de estudos publicados entre 2003 e 2012, nos idiomas inglês e português, e indexados nas bases de dados PubMed, LILACS e SciELO. Nas buscas foram utilizadas as palavras-chave: Prematuro, Prematuridade, Linguagem, Prematurity, Language, Speech-Language Pathology. Foram identificados 57 artigos, dos quais 13 foram incluídos na revisão sistemática.

Síntese dos dados: Os resultados apontaram uma associação entre prematuridade, baixo peso ao nascer e desenvolvimento de linguagem. Nos estudos que realizaram comparações entre crianças nascidas pré-termo e crianças nascidas a termo, houve evidências de que os prematuros apresentaram pior desempenho nos indicadores de linguagem. Também foi observado que as crianças nascidas com menor peso ao nascer obtiveram pior desempenho nas avaliações de linguagem quando comparadas às crianças com maior peso e idade gestacional mais próxima à 37 semanas. Em relação ao tipo de linguagem avaliado, a expressiva mostrou-se mais prejudicada que a receptiva. Como fatores de proteção ao desenvolvimento de linguagem foram apontadas a maior escolaridade dos pais e maior renda familiar. E em contrapartida, o menor peso ao nascimento e o maior grau de prematuridade surgiram como fatores de risco.

Conclusões: A prematuridade e o baixo peso ao nascer representam riscos para o desenvolvimento linguístico das crianças, especialmente nos primeiros anos de vida. Sendo assim, torna-se fundamental que os pediatras estejam atentos ao desenvolvimento da linguagem destas crianças para tratamento adequado.

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Introduction

In Brazil, in 2011, 285,592 infants were born preterm and 248,217 had low birth weight, corresponding to 9.80% and 8.52% of total births (2,913,160), respectively.¹ Gestational age (GA) and birth weight (BW) have been identified as important biological risk factors for alterations in children's language development.²⁻⁴

The literature in the area of neonatology indicates that although technological and scientific developments have contributed significantly to the decrease in mortality among preterm infants, prematurity and low BW still appear as causes of neonatal mortality and morbidity, showing a strong clinical and epidemiological impact.⁵ Therefore, the follow-up of this group is important to health promotion.

Studies have shown that the lower the GA and the BW, the greater is the risk of developmental disorders.⁶ The risks of developmental alterations in these children are higher not only because they are more susceptible to diseases, but also because they are exposed to iatrogenic factors, such time away from the mother, prolonged time in the incubator, drug effects, mechanical ventilation, and stress due to long-term manipulation.⁷ Thus, newborns who resist perinatal complications become prone to manifest alterations in their development and may have neurological, sensory, and language deficits.⁸

The literature has shown a significant delay in language development of children born preterm and with low BW,⁹ and the early recognition of developmental disorders can

help to include these children in specific intervention programs, thus minimizing the risk of irreversible dysfunctions and improving their quality of life.^{7,10} Therefore, this study aimed to systematically review research on the association between prematurity, low BW, and language development in Brazilian children.

Methods**Research strategy**

A systematic review was carried out in the PubMed, LILACS, and SciELO databases, using combinations of the following keywords: prematuro linguagem, prematuridade linguagem, prematurity language, speech-language pathology (always including the word AND). The keywords were selected by researching MeSH (PubMed) and DeCS terms (LILACS and SciELO).

Selection criteria

The criteria used for study inclusion were: original articles that established an association between GA, BW, and language development in Brazilian children; studies published in the last ten years (January/2003 to December/2012) in Portuguese and English, and that used the cohort, case-control, longitudinal, cross-sectional, descriptive analytical, and retrospective methods.

The dependent variables used in this review were the variables obtained as the result of standardized tests (receptive language and/or expressive language). The independent variables were GA, BW, gender, age at time of evaluation, family income, and maternal level of education.

For the purposes of the present study, prematurity was considered at three levels: borderline preterm (GA 35-36 weeks), moderately preterm (GA 31-34 weeks), and extremely preterm (GA \leq 30 weeks). Newborns with low BW were classified as low BW ($< 2,500$ g), very low birth weight ($< 1,500$ g), and extremely low BW ($< 1,000$ g).¹¹

Data analysis

The initial search resulted in a total of 57 articles, of which 36 were excluded after the title and abstract were read, as they did not address the subject, were literature reviews, or were case reports. Of the remaining 21 articles, eight were excluded due to duplication. The 13 selected articles were read and included in the review. The results of the assessed studies were analyzed descriptively.

Results and discussion

The characteristics of the studies, such as the methodology used, age of the assessed children, and sample size are described in Table 1. Most of the studies assessed children younger than 2 years and sample size varied. The years 2009 and 2012 featured the greatest number of articles published on the subject.

Table 2 describes the language assessment tools used in the studies, demonstrating a variety of tests, scales, and lists, among techniques used by the authors.

Regarding the locations where studies were conducted, eleven were performed in the Southeast Region, whereas the South and Northeast Regions were represented by one study each.^{2,8,9,12-21} It was not possible to make comparisons between the results obtained in these regions due to the difference in the number of studies carried out by region, which is indicative of the need to perform studies in other Brazilian regions.

Language skills of premature infants were evaluated in two different manners by the studies: those that focused on expressive language^{2,15} and those that addressed both receptive and expressive language.^{8,9,12-14,16-21} The two studies that evaluated expressive language only^{2,15} found a delay in language development in preterm children when compared to children born at term, and one found a significantly lower difference in the vocabulary in all the semantic categories.¹⁵

In the 11 studies that analyzed the receptive and expressive language, four found significant differences in both types of language,^{9,12,13,17} three found differences in expressive language only,^{8,14,19} two did not differentiate the type of language but demonstrated significant difference,^{16,20} and two found no difference in any of the language types.^{18,21}

Among those that found significant differences in both types of language, the difference found in expressive language was more significant when compared to receptive language.^{12,13,17} In one study that showed a significant difference,⁸ the most delayed expressive language item in

premature infants was first word production ($p=0.0096$). In a study that showed no difference between the full-term and preterm children,¹⁸ a possible explanation reported by the authors was the assistance parents received in the follow-up carried out at the service, which included information on how to stimulate the child's language. Therefore, the review suggests that expressive language was more affected than receptive language in premature infants.

The language acquisition delay in these children may be associated with brain injuries related to neonatal complications,^{8,22} with central nervous system immaturity,^{8,22,23} and the child's interaction with the environment and with people.²⁴ The maturational processes and the individual's interactions with the environment are influenced by organic, psychological, social, and economic conditions that may have a negative or positive impact on child development.²⁵ Therefore, the interaction between parent and child becomes of utmost importance for child development, especially in preterm infants. Thus, it is very important that pediatricians and speech therapists are aware of all these aspects when observing the language of premature infants, so that, if necessary, early referrals and interventions can be performed.

In the six studies that compared language development between groups differentiated by GA or BW,^{9,13,15-17,21} it was observed that children born with lower GA and BW showed the worst results in language assessments. Most studies that performed comparisons between groups differentiated by GA found that samples of preterm children had poorer performance on language assessment tests when compared to children born at term, and the lower GA was associated with children's lower phrasal extent ($p=0.016$),¹⁵ losses in the expressive language area at 4-6 months and 10-12 months of age,¹³ and losses in the expressive language area in children aged 12-36 months.²¹

In the study by Schirmer et al.,⁹ which used Denver II, Bayley II, and the Developmental Sequences of Language Behavior by Nicolosi for evaluation, it was observed that the mental, psychomotor, and behavioral development in newborns with BW $< 1,500$ g showed a statistically significant association with language development, whereas in infants with BW $> 1,500$ g, this association remained significant in the mental aspect.⁹ Thus, the language development delay may be associated with delays in other areas of development, especially in infants with lower BW.

In the three studies that compared language assessment results with BW,^{15,17,21} lower BW was associated with the worse performance in expressive language,²¹ lower number of words ($p=0.045$), and lower phrasal extension ($p=0.019$).¹⁵ When comparing low BW with very-low BW preterm infants at age 12-24 months, infants with very low BW showed higher losses in the assessed areas compared to those with low weight.¹⁷

Oliveira et al.⁸ compared full-term newborns small for GA (FTNB/SGA) with preterm newborns adequate for GA (PTNB/AGA) using the Early Language Milestone (ELM) scale. Both groups had equivalent linguistic production for chronological age up to 6 months. This result differs from that found by Pereira and Funayama,¹³ who found differences in language between the groups at the ages of 0-3 months, even those with corrected ages. The items considered in the assessments of both studies are different at the age

Table 1 Description of studies on language development in preterm children.

Author(s), (year)	Study method	Age of participants (months)	Sample size	Main results
Oliveira LN et al. (2003) ⁸	Case-control longitudinal	6-18	20	No difference was observed between FTNB/SGA, PTNB/AGA, and the FTNB/AGA infants in the first semester of life. After 9 months delay in babbling was observed, and in the 12 th month polysyllabic babbling and production of first words were delayed.
Meio MD et al. (2004) ¹²	Cross-sectional with cohort analysis	48-71	129	Premature children showed worse performance in the areas of vocabulary and comprehension when compared with children born at term, with vocabulary more impaired than comprehension.
Pereira MR, Funayama CA (2004) ¹³	Case-control longitudinal	2-15	69	Preterm AGA and SGA children with normal neurological assessment and neuromotor development, showed delay, especially in expressive language.
Ishii C et al. (2006) ¹⁴	Cross-sectional descriptive	48-59	20	Preterm children showed changes in language development at 4 years of age at the TEPsi test.
Shirmer CR et al. (2006) ⁹	Cross-sectional	36	69	Premature children had higher risk of language delay. Mental, psychomotor, and behavioral delay were significantly correlated with language development in infants with birth weight < 1,500 g; with weight > 1,500 g, the significance was associated only with the mental score.
Bühler KE et al. (2009) ²	Case-control longitudinal	1-18	32	Expressive language development occurred significantly later in preterm infants with very-low birth weight when compared to full-term infants.
Isotani SM et al. (2009) ¹⁵	Case-control retrospective	Not available	118	Preterm infants and those with low birth weight have a higher occurrence of expressive language delay. These children have a significantly smaller vocabulary than children born at term at the same age, in all semantic categories.
Lamônica DA, Picolini MM (2009) ¹⁶	Cross-sectional	6 - 24	30	Preterm children showed language delay in two periods: 6-12 and 12-24 months, and at the period of 12-24 months, the delay was more significant.
Lamônica DA et al. (2010) ¹⁷	Case-control cross-sectional	12-24	40	Preterm infants and those born with low or very-low birth weight showed higher losses in the expressive language area, when compared to children born at term.
Lima MC et al. (2011) ¹⁸	Case-control longitudinal	12-24	44	The differences were not statistically significant. The transient language alterations found in premature infants at 12 months normalized at 24 months, thus demonstrating the importance and the need to educate parents concerning the appropriate intervention, in order to prevent alterations from persisting throughout early childhood.
Eickmann SH et al. (2012) ¹⁹	Case-control cross-sectional	6-12	135	Significant difference was observed between preterm and full-term children regarding expressive language, with premature males showing worse performance.
Fernandes LV et al. (2012) ²⁰	Cross-sectional	18-24	58	Very low birth weight preterm infants more often showed alterations in language, social-emotional, and adaptive behavior.
Silveira KA, Enumo SR (2012) ²¹	Cross-sectional	12-36	40	Preterm and low birth weight infants showed difficulties in cognitive, language, and motor performance, as well as behavioral problems in the first three years of life.

FTNB, full-term newborn; PTNB, preterm newborn; AGA, adequate for gestational age; SGA, small for gestational age; TEPsi, psychomotor development test.

Table 2 Assessment tools used in the studies.

Assessment tools	Type of language assessed	Studies that used the tools
ELM	Receptive and Expressive	Lamônica DA et al. ¹⁷ ; Oliveira LN et al. ⁸ ; Lima MC et al. ¹⁸
Bayley III	Receptive and Expressive	Eickmann SH et al. ¹⁹ ; Silveira KA, Enumo SR ²¹ ; Fernandes LV et al. ²⁰
LAVE	Expressive	Isotani SM et al. ¹⁵
POI	Receptive and Expressive	Lamônica DA, Picolini MM ¹⁶
TEPSI	Receptive and Expressive	Ishii C et al. ¹⁴
PELCDO	Expressive	Bühler KE et al. ²
Denver II; Bayley II; Language Assessment	Receptive and Expressive	Shirmer CR et al. ⁹
WPPSI-R	Receptive and Expressive	Meio MD et al. ¹²
Language scripts	Receptive and Expressive	Pereira MR et al. ¹³

ELM, Early Language Milestone scale; LAVE, expressive vocabulary evaluation list; POI, portage operational inventory; TEPSI, psychomotor development test; PELCDO, protocol for expressive language and cognition development observation; WPPSI-R, Wechsler Preschool and Primary Scale of Intelligence-Revised.

of up to 6 months; while the ELM scale considers smiling and lip vibration the first manifestations of language, the assessment protocol used by Pereira and Funayama¹³ only considers vowel emissions. In the 9th month, the items assessed in both tools are more similar and the results found in the two studies indicated a lower production of babbling, although the ELM scale showed that these findings also occurred in full-term AGA children. Therefore, it is difficult to compare results in language studies because of the different instruments used for assessment.

Regarding the age at which premature infants showed a more meaningful language delay, three studies followed children longitudinally and were able to analyze this aspect.^{8,13,16} Oliveira et al.⁸ evaluated the expressive language in two groups of children, FTNB/SGA and PTNB/AGA, at 6, 9, 12, and 18 months and found that until the 6th month, the infants showed a normal performance for their age, and only in the 12th month was there a statistically significant delay in the FTNB/SGA group, which remained with polysyllabic babbling, and in the PTNB/AGA group, in the production of first words. Pereira and Funayama¹³ reviewed children's language at five different levels: I (0-3 months), II (4-6 months), III (7-9 months), IV (10-12 months), and V (13-15 months).

As for receptive language, preterm children had a significantly worse performance at level I, and in expressive language, performance was worse in levels II and IV. Based on these results, children up to 12 months of age were more likely to have language development delays. Lamônica and

Picolini¹⁶ observed children's language in two periods, 6-12 months and 12-24 months, and although in both periods the results were significantly worse for preterm infants, more children had language delay in the period of 6-12 months than at 12-24 months. Thus, studies have shown an evolution of preterm infants during the first two years of life, with language development drawing nearer to the development of children born at term. This development is known as the "catch-up phenomenon," which may occur with both preterm and low BW newborns.²⁴

Another aspect discussed in the articles was whether gender influenced language development.^{8,15,19,20} In the four analyzed studies, two of them found no statistically significant difference,^{8,15} whereas the other two indicated that male gender was a risk factor for alterations in language development.^{19,20}

In a systematic review of literature carried out in national and international databases between January 2005 and June 2010, one of the aspects analyzed in preterm children was language.²⁶ A total of ten articles were associated with language, and although many did not include Brazilian children, a comparison might be relevant. Vieira and Linhares²⁶ identified in some studies that male gender was a risk predictor for language delay in premature infants. There is still no consensus among the results, but there is an indication that male children are at increased risk for the language development delay.

Language acquisition and development involve multiple aspects, and in addition to the physical and biological factors, it is important to consider social and cultural factors that involve variables such as the environment where the child lives, the quality of adult-child interaction,²⁷⁻²⁹ and the degree of parental education and family income. In this review, one study assessed maternal education and *per capita* income²¹ and two analyzed parental education and family income.^{15,26} In one study, poorer performance in receptive language was correlated with low maternal educational level.²¹ In the review by Vieira and Linhares,²⁶ low educational level was considered a risk factor for language development, whereas higher family income was a protective factor. Isotani et al.¹⁵ found no significant differences between maternal education and the child's expressive language, but when correlating income with child's phrasal extension, a positive association was observed ($p=0.008$), so that the higher the family income, the greater the child's phrasal extension.

Child development, especially that related to language, is greatly influenced by the social environment in which the child lives,^{30,31} and low income and educational level are variables that may be related to fewer opportunities for interactions between adult and child, collapse of the family structure, and school abandonment. Therefore, children born preterm whose families are in vulnerable situations may be more prone to developmental alterations and, thus, it is extremely important for health professionals to be aware of these issues.

Conclusion

When associating preterm birth with child language development, the literature demonstrated that prematurity is a

risk for language development alterations, especially during early years. In the studies that compared preterm children and children born at term, there was evidence that preterm children had poorer performance in development indicators related to language. When considering the types of language, the expressive language was more impaired than the receptive.

Higher parental education and family income were identified as protective factors for language development, whereas lower BW and higher degree of prematurity were identified as risk factors. In the studies that analyzed different levels of prematurity and BW, it was observed that children born with lower GA and lower weight had worse performance in language assessment tests than children with higher weight and GA closer to 37 weeks.

As for the procedures used for language assessment, it was observed that a wide variety of tools were used in the studies, which makes it difficult to compare them. Thus, the authors emphasize the need for researchers to study the different tools in order to select the best for their objectives.

Hence, preterm infants and families in more vulnerable situations may be more prone to development alterations. Considering this issue is of utmost importance, health services have developed actions to follow these children regarding language development. Thus, it is essential that pediatricians be aware of the language development in these children so that adequate treatment can be provided.

Conflicts of interest

The authors declare no conflicts of interest.

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